

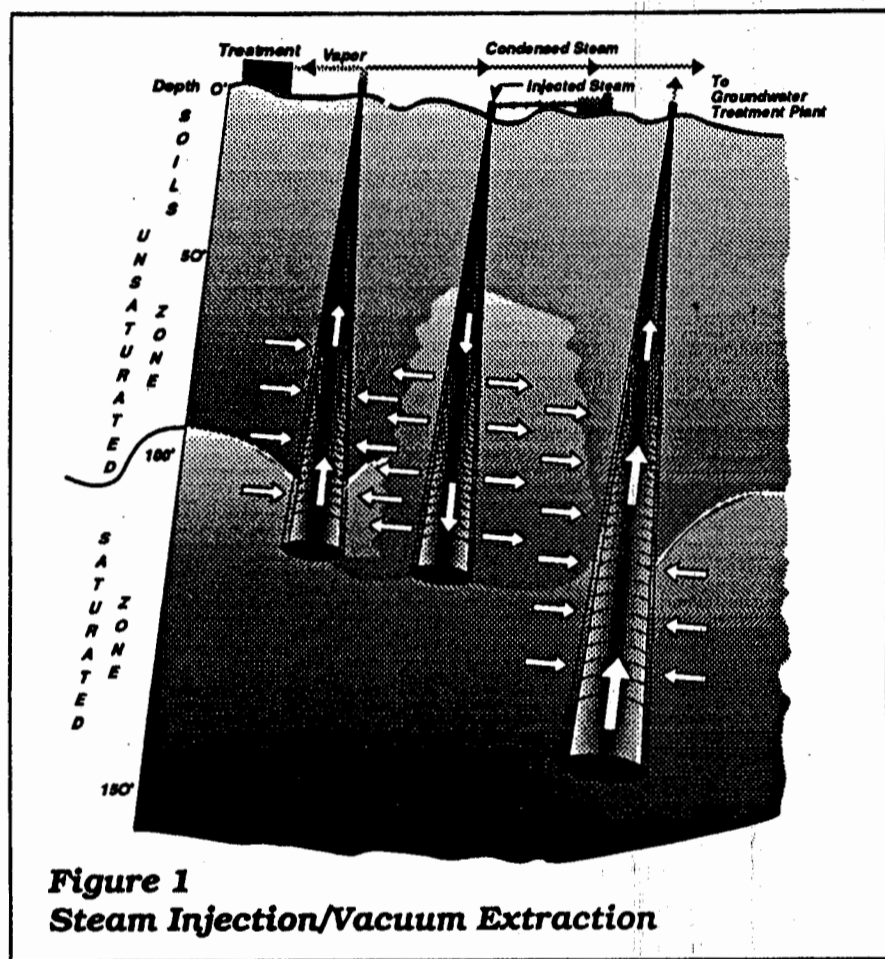
# THE FACTS

Information About  
Environmental Cleanup  
at McClellan AFB.

Produced by McClellan AFB Environmental Management

Number 14

## Data Collection Resumes for Design of a Steam Injection Treatment System



**Figure 1**  
**Steam Injection/Vacuum Extraction**

McClellan Air Force Base has resumed collecting information to support the design of a steam injection/vacuum extraction (SIVE) pilot-scale treatment system (Figure 1). The SIVE treatment system will be used to remove contaminants from the groundwater near Site 22 in Operable Unit C1 (Figure 2).

### Background

Data collection to support design of a SIVE system near the waste pit at Site 22 (The Facts, No. 8) was originally focused for use in the vadose or unsaturated zone. The unsaturated zone lies above the water table and is an area composed of soil, air, and some water. However, this data collection was halted during spring 1992 because conclusions from the study showed that certain contaminants mobilized by the SIVE process could not be treated economically. Trichloroethylene (TCE) is the primary contaminant targeted for treatment with the SIVE technology.

Consequently, the project was refocused for application in the satu-

rated zone just west of the Site 22 waste pit. The saturated zone is below the water table and is where the groundwater lies. Steam will be injected below the groundwater table (approximately 90 and 140 feet below ground). Groundwater in the area is approximately 100 feet deep.

Planning for the pilot test began in summer 1992. The SIVE treatment technology will be tested in a core of soil and groundwater having a diameter of about 150 feet. The SIVE test will take approximately one year to complete. This time frame includes the pre-design investigation, bench-scale treatment design, and the pilot system design, installation, and operation.

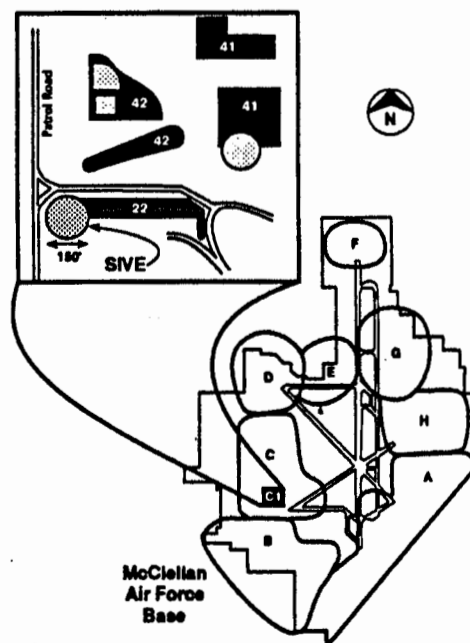
### SIVE Application in the Groundwater

The SIVE process involves injecting steam into the ground at and below the water table, and collecting the condensed steam, groundwater, and steam vapors. The high temperature and pressure of the steam cause the contaminants (primarily

semivolatile and volatile organic compounds, such as TCE) in the groundwater and soil pores to form a highly concentrated wave of contaminants in front of the steam. The wave of contamination is intercepted and removed by a series of extraction wells at the edge of the treatment zone.

The SIVE pilot system will include a network of several types of wells to monitor and control the movement of the steam, condensed steam, groundwater, and soil vapor resulting from the steam injection process. The types and associated functions of these wells are summarized below. Figure 3 shows the network of wells as they are planned to be installed.

- **Steam Injection Wells** - to inject steam into the saturated zone
- **Temperature Monitoring Wells** - to track the location of the steam
- **Piezometers** - to measure groundwater levels and soil vapor pressures
- **Soil Vapor Extraction Wells** - to remove vapors from the soil above the groundwater
- **Extraction Wells** - to remove steam vapors, groundwater, and condensed steam



**Figure 2**  
**Site 22 in Operable Unit C1**

## Data Collection to Support Design

From January through March 1993, predesign field work will be conducted to collect data necessary for the design of the SIVE treatment system and to install several of the wells (see Schedule). The data to be collected includes:

- **Soil Types**

The type and arrangement of soils in the treatment zone will be studied to help determine where wells will be placed.

- **Contamination**

The type, amount, and distribution of contaminants in the groundwater, soil, and soil gas will be identified to clarify the areas in the treatment zone that need the most treatment.

- **Groundwater Hydrology**

Tests will be performed on a few wells installed during the predesign field work. The tests will show the groundwater flow patterns in the treatment zone during the SIVE pilot test and will help determine the best well spacing.

- **Bench-Scale SIVE Testing**

Some of the soil samples collected during the predesign field work will be taken to a laboratory and flooded with steam. The bench-scale tests will be used to mimic the application of SIVE on a pilot-scale basis. The test will also be used to study the formation of a contaminant wave and rates of contaminant removal from the samples.

### Performance Expectations for SIVE

Information collected during preliminary SIVE tests near the Site 22 waste pit indicates good removal of most contaminants from the waste pit soils. Application of SIVE in the groundwater is expected to produce similar results, based on known

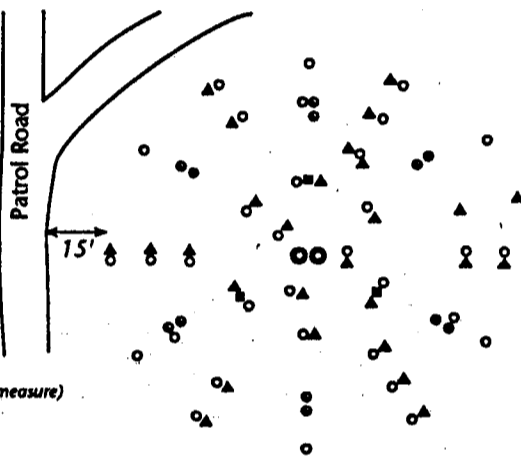
groundwater contamination in the pilot test area. Use of the SIVE technology in the groundwater shows promise for efficient removal of the contamination beneath Site 22, while reducing the cost of groundwater treatment.

McClellan AFB has formed a public/private partnership with several companies, as well as the U.S. EPA Technology and Innovation Office. The companies include the Monsanto Corporation, the DuPont Corporation, the Dow Chemical Company, and the Xerox Corporation. The companies will assist McClellan in testing the SIVE technology by offering technical advice, participating in document reviews, and partially funding the development of the technology. If the tests prove successful, the companies hope to use the SIVE technology at their own facilities.

**Figure 3  
Well Network**

**LEGEND:**

- Steam Injection Well
- Extraction Well
- Piezometer (water level measure)
- ▲ Temperature Well
- Vapor Extraction Well



### Schedule

**Fieldwork**

Jan-Mar 1993

**Process & Detailed Design**

June-Oct 1993

**Pilot System Installation**

Nov 1993-Feb 1994

**Pilot System Operation**

Feb-June 1994

**Performance Evaluation Report**

Fall 1994

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